Using a Prism to Reject or Select Harmonic Reflections in an X-ray Monochromator

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Introduction: The angle by which an x ray deviates from its original direction when it passes through a refractive prism is proportional to the square of the x-ray's wavelength. This effect was used to discriminate between different harmonic orders of a two-crystal non-dispersive monochromator.

Methods and Materials: Acrylic blocks were used as refractors and put in the path of the beam between two non-dispersive crystals. The angle of the refraction blocks was adjusted so that the upper surface of the blocks made an angle of a few degrees with the beam.

Results: Two cases are studied: In the first, a refractive prism allows tuning of the silicon [333] reflection to the peak of its double-crystal rocking-curve while the higher-order harmonics are suppressed, with much of the harmonic rejection being controllable by the prism's angle; In the second, slightly tuning the monochromator's second crystal allows the selection of a specific harmonic order from among [333], [444], and [555] reflections. A separation was achieved between the [333] and the [444] harmonics of up-to 80 micro-radians. Harmonic orders could be selected by tuning the second crystal since the width of the rocking-curve is only on the order of micro-radians.

Conclusions: The concept of using a separate refractive element in designing a monochromator system for rejecting or selecting harmonics can be useful for other applications at synchrotron radiation facilities.

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References:

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